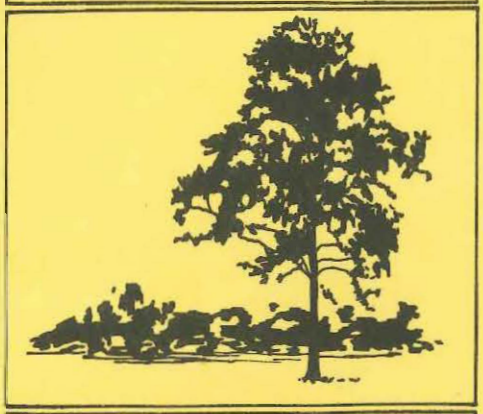

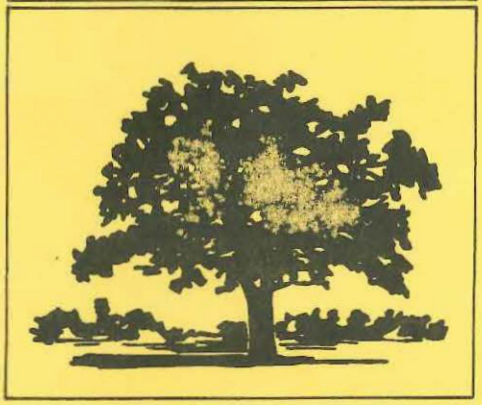

# FOREST PEST CONDITIONS IN WISCONSIN

# ANNUAL REPORT 1975

DEPARTMENT OF NATURAL RESOURCES
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# FOREST PEST CONDITIONS IN WISCONSIN ANNUAL REPORT - 1975

*Compiled and Edited by Donald W. Renlund*
*Supervisor, Forest Pest Control*

DEPARTMENT OF NATURAL RESOURCES
Division of Resource Management
Bureau of Forestry

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## PREFACE


This report is a compilation of information from DNR pest management personnel, department foresters, and cooperators in other agencies. Our sincere thanks to them, to the typists at Southern District Headquarters, and the Typing and Printing Section at Pyare Square for their contributions toward getting the report into its final form.



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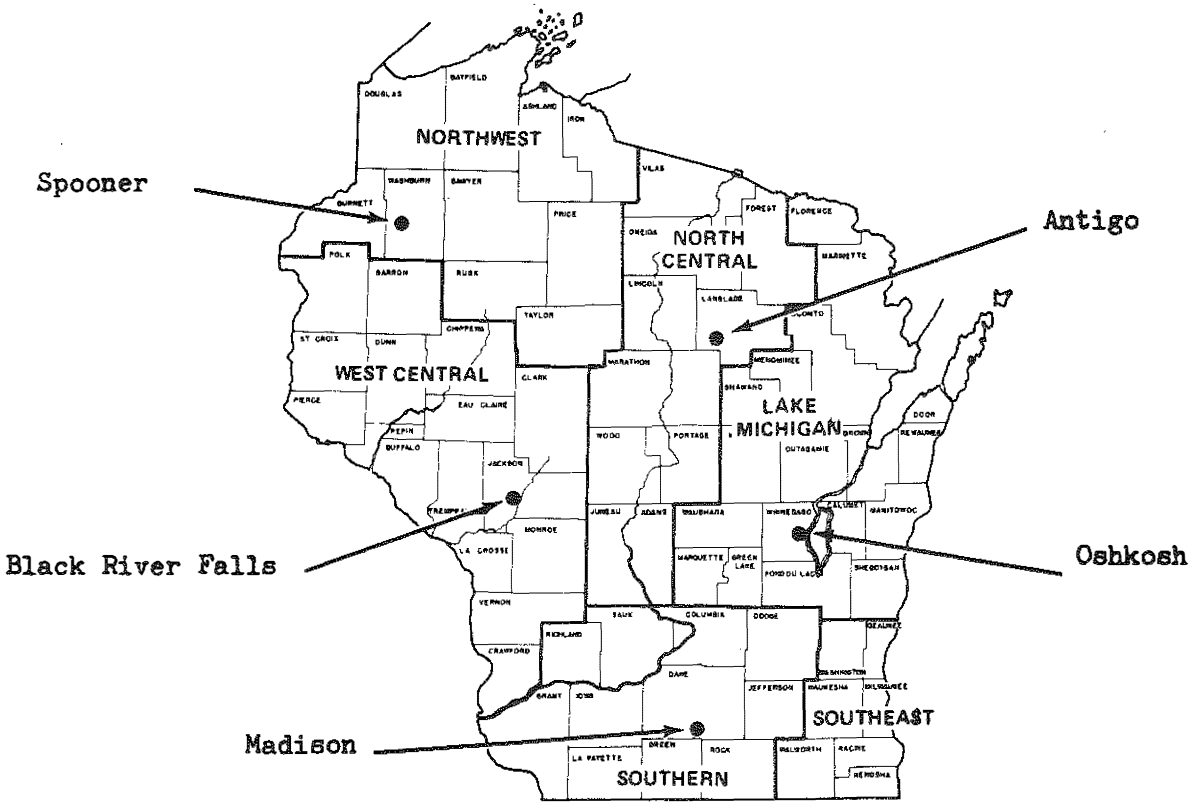

Highlights of Forest Pest Conditions - 1975

Pine bark beetles were destructive in many parts of the state. An abundance of suitable wood and an extended period of dry weather provided ideal conditions for localized outbreaks to occur.

Early summer populations of introduced pine sawfly were locally high in the northern 2/3 of the state. Anticipated high late summer populations did not materialize.

Trapping of male European pine sawflies by UW-Madison researchers suggests that the southern two tiers of Wisconsin counties are generally infested.

Larch sawfly defoliation was severe to complete in many northern larch stands.

Cankerworm and linden looper activity were widespread within the state. Defoliation of oaks, elms and basswood was most severe in Adams, Columbia, Marquette and Sauk counties.

Severe defoliation of aspen by the large aspen tortrix in parts of Forest and Langlade counties made the wood difficult to peel according to loggers. Heavy moth flights were of concern to residents of heavily infested areas.

Spruce budworm defoliation was evident on nearly 60,000 acres of spruce-fir type in Forest, Oneida and Vilas counties. Smaller areas of defoliation were apparent in Bayfield and Iron counties.

Jack pine budworm populations were erratic in Bayfield and Douglas counties and severe defoliation of jack pine was minimal. A microbial insecticide and an insect growth regulator were applied by airplane to determine their effectiveness against the insect.

Oak leaf tiers defoliated more than 3,000 acres of northern red and northern pin oak in Menominee County.

Severe infestations of pine needle miner were observed on jack pine in Clark, Jackson and other western counties.

Saddled prominent larvae caused light defoliation on a 40-acre area near Baileys Harbor (Door County). The last outbreak in Door County occurred in 1968.

Forest tent caterpillar sightings were widespread and more common than usual, but no damaging numbers were seen anywhere.

A cooperative inter-agency statewide trapping program for gypsy moths produced single catches of males at Elkhart Lake (Sheboygan County) and Manitowoc (Manitowoc County). Three males were caught in one trap in Appleton (Outagamie County). Releases were made of a larval parasite and a pupal parasite. Activities related to the parasite survey continued to expand.

A preliminary evaluation was made of the effectiveness of several insecticides against walnut bud insects.

The presence of Dutch elm disease was confirmed in Bayfield and Iron counties. It is now known to occur in all Wisconsin counties.

Diplodia tip blight was found on dying shoots of red pine nursery stock in two state nurseries, and on red and Scotch pine shoots in several plantations and windbreaks.

Preliminary results of investigations of butternut dieback and cankering indicate an unidentified fungus may be involved in the cankering. Cause of the dieback is unknown.

DNR and USFS personnel continued a cooperative ecological study of red pine shoot blight on the Northern Highland State Forest (Vilas County).

Lophodermium needle cast defoliated all ages of red pine in Oneida and Vilas counties. Its rate of spread within infected crowns is being evaluated. Christmas tree growers can protect their Scotch pine by timely application of fungicides.

Swiss needle cast was found in 10 out of 11 Douglas fir Christmas tree plantations suspected of harboring the disease.

Air pollutants produced needle blight symptoms of varying severity on sensitive white pine in widespread locations. Up to 15% of the pines were affected in some areas. There was no increase in the number of blighted trees over previous years in long-established plots in Green and Richland counties.

Needle droop occurred in field plantings of red pine in three northern counties late in the summer of 1974. Obvious needle discoloration was not apparent until 1975. This was the first major occurrence of this condition since 1967.

Nine fungicides were tested for control of foliage diseases on a variety of deciduous shrubs at F. G. Wilson Nursery at Boscobel (Grant County).

Unusually high populations of meadow voles girdled and killed young pines in numerous Christmas tree and other plantations in northern counties.

Widespread drought conditions in July and August resulted in extensive mortality to jack pine seedlings and saplings in the western half of the state. Spring-planted red pine was also killed in one plantation.

## MAJOR FOREST INSECTS

### COLEOPTERA

Bronze Birch Borer - *Agrilus anxius* Gory
Reports of injury to ornamental white birch, and tree mortality, were received from most parts of the state. Many ornamental birches were killed, and others severely damaged in the Lake Michigan District, where there were more complaints of borer activity than in previous years.

Elm Flea Beetle - *Attica carinata* Germar
Severe defoliation occurred on scattered elms in parts of Langlade and Marathon counties.

Pales Weevil - *Hylobius pales* (Herbst)
Localized pockets of infestation were noted in Green Lake and Shawano counties. These were associated with cutting operations and moisture extremes. Populations were low in the west central counties.

Pine Root Collar Weevil - *Hylobius radicis* Buchanan
Damaging populations were found in Adams, Grant, Green Lake, Marquette, Shawano, Waupaca and Waushara counties. They were usually associated with Scotch pine plantations. Much lighter infestations occurred in red pine plantations which had been exposed to wide extremes of temperature and moisture.

Growers were controlling the weevil in most commercial Scotch pine Christmas tree plantations in the west central counties with benzene hexachloride. Only minor mortality was apparent in jack and red pine plantations in that part of the state.

Pine Root Weevil - *Hylobius rhizophagus* Millers
Eighty to 100 acres of infested 20 to 30-year-old jack pine plantations, on sandy soils in Eau Claire and Jackson counties, were cut to salvage merchantable wood (5-7 cords/acre). High incidence of branch mortality was reported in mixed pole-sized stands of red and jack pine in Adams County. Flagging and tree mortality continued in known infestations in Burnett and Washburn counties.

Pine Engraver Beetles - *Ips pini* (Say)
Due to market conditions, numerous piles of pine pulpwood were left in the woods through the spring and summer of 1975. These, combined with an abundance of suitable slash and an extended period of dry weather during late summer and early fall, provided ideal conditions for build-up of bark beetles over much of the state. Infested trees were also apparent in plantations being subdivided into lots, and in other types of disturbed areas. Second-generation beetles were abundant enough in places to successfully invade living jack and red pine. One 10-year-old red pine plantation in Washburn County (Sec. 14, T38N, R13W) was invaded by bark beetles even though there was no apparent source of build-up nearby.

Damage observed was most severe in Clark, Eau Claire, Jackson, Marathon, Marinette, Oneida, Sauk, Washburn, and Waushara counties. Patches of yellowing or browned trees were evident by mid-September although some

trees were observed then on which the inner bark was almost completely riddled by beetle galleries and the foliage still retained its normal dark green color. Additional mortality is expected to appear in jack and red pine in the spring of 1976.

Pine Sawyers - *Monochamus* spp.
Reports of attacks on pulpwood piles and in pine stands growing on light sandy soils were reported from a few widespread locations.

White Grubs - *Phyllophaga* spp.
Damage to roots of seedlings by grubs was reported as a factor in poor survival in some plantations in Clark and Eau Claire counties.

White Pine Weevil - *Pissodes strobi* (Peck)
Populations were down in the northwest and north central districts with only scattered weeviled leaders of white pine and Norway spruce. In Clark and Jackson counties, 10 to 20% of open grown white pines were weeviled and surrounding jack pine reproduction was also attacked. Wet overwintering conditions and a wet spring had an adverse effect on adult weevils causing a marked reduction in injury to white pine over most of the Lake Michigan District. However, noticeable attacks on red pine occurred near Amberg in Marinette County.

Native Elm Bark Beetle - *Hylurgopinus rufipes* (Eichhoff)
This important vector of Dutch elm disease is found throughout the state, but causes most destruction in the northern counties where there is no known competition from the smaller European elm bark beetle.

Smaller European Elm Bark Beetle - *Scolytus multistriatus* Marsham
Populations continue to be high in the east central and southern counties.

A Weevil - *Sciaphilus asperatus* Bonsdorff
Leaf chafing of ground vegetation and hardwood reproduction was common throughout the hardwood stands of eastern Langlade and western Marathon counties. Many calls for assistance were received when the adult weevils entered houses in late summer.

COLLEMBOLA

Springtails were unusually abundant on snow and leaves in forested areas of Jackson County in mid-March. Several reports of the insect were received from foresters and the general public.

DIPTERA

Balsam Gall Midge - *Dasineura balsamicola* (Lintner)
Christmas tree growers reported heavy infestations in balsam fir plantations in Langlade, Lincoln, Oneida and Vilas counties. Control efforts with malathion failed to protect the trees. Most of the insecticide applications were done with a backpack mist blower. One aerial application was made on 20 acres of Christmas trees which were ready for harvest. (SENW Sec. 29, T31N, R12E). Further work is needed with pesticides, and other approaches to pest control, to reduce the impact of the midge on this important forest product.

Red Pine Needle Midge - *Thecodiplosis piniresinosae* Kearby
Light infestations were noted in Marquette and Waushara counties following 7 consecutive weeks of drought.

HEMIPTERA

Lace Bugs -

Undetermined species of lace bugs caused severe browning of bur oak *(Quercus macrocarpa)* foliage in northern Adams County, and in parts of Marathon, Portage and Wood counties. Elm foliage turned brown in eastern Langlade and Marathon counties, and in western Menominee County following heavy feeding by lace bugs.

High populations of lace bugs on basswood in wastern Dane and northern and eastern Iowa counties caused yellowing of leaves in early August on steep east-facing slopes. As many as 200 lace bugs per leaf were observed in one heavily infested area covering nearly 100 acres.

HOMOPTERA

Pine Spittlebug - *Aphrophora parallela* (Say)
Spittle masses were noted in most jack pine stands in the northwest district, but no heavy infestations were reported.

Nymphs were numerous and spittle masses were reported in all pine areas in the west central counties. One Christmas tree grower requested information on control. Adult spittlebugs were observed on jack and white pine in Jackson County on September 15. Heavy localized infestations were noted on Scotch pine in Door, Marquette, Shawano, Waupaca and Waushara counties, and on jack pine in Florence and Marinette counties.

Saratoga Spittlebug - *Aphrophora saratogensis* (Fitch)
High populations on 85 acres of young red pine plantations on the Northern Highland State Forest (Vilas County, Sections 2 and 11, T42N, R6E) were successfully treated by aerial application of malathion. Fifteen acres of private plantations were treated by the owner in Oneida County.

An old infestation had killed many trees and deformed others in a 40-acre plantation west of Amberg in Marinette County. A similar infestation killed and deformed trees over a 5-acre area in northern Marquette County, but adjoining trees had not been affected.

Populations were light and no damage was observed in other parts of the state.

Pine Tortoise Scale - *Toumeyella numismaticum* (Pettit & McDaniel)
Scattered infested jack pines were observed, mostly in the Northwest District and in Florence and Oconto counties in the northeast. An infested Scotch pine plantation was reported near Wild Rose (Waushara County).

HYMENOPTERA

Introduced Pine Sawfly - *Diprion similis* (Hartig)
Early summer populations were variable, scattered and locally high across the northern 2/3 of the state causing light to almost complete defoliation

of white pine growing in the open, in windbreaks and as ornamentals. Occasional Scotch and jack pine were also defoliated. A few hundred acres of jack pine and white pine along Wolf Creek in Polk County were 80% defoliated. Anticipated high populations in late summer did not materialize. Most of the trees severely defoliated in 1974 in the Northwest District survived; however, some top and branch mortality did occur.

Birch Leaf Miner - *Fenusa pusilla* (Lepeletier)
Locally heavy infestations were reported across the northern counties. Some infested stands were observed in the southern part of the state. Severe browning and defoliation occurred on wild birch in Clark County, and parts of Langlade, Lincoln, Marathon and Portage counties. Damage to ornamental white birches was reported in many west central and southern communities. The insects were not as abundant as they had been the previous two years, in the eastern counties.

Red-Headed Pine Sawfly - *Neodiprion lecontei* (Fitch)
Populations increased from 1974 levels in the West Central, North Central, and Lake Michigan districts. Landowners treated red pine plantings of 13 acres in Langlade County and 17 acres in Oneida County, with malathion, to prevent tree mortality. Single colonies defoliated branches on occasional open grown jack pine in Clark, Eau Claire, and Jackson counties. Larger numbers defoliated individual jack pines in Florence, Marinette, Marquette, Oconto, Waupaca and Waushara counties. Only a few scattered colonies were noted in the northwest district.

White Pine Sawfly - *Neodiprion pinetum* (Norton)
The abnormally warm summer temperatures allowed a second generation to develop in Grant County. Noticeable defoliation of four white pine plantations was reported at the following locations: SENE Section 21, T1N, R2W; NWSE Section 24, T2N, R3W; SWSE Section 25, T3N, R3W; NENE Section 20, T4N, R1W; and NESE Section 2, T6N, R5W.

European Pine Sawfly - *Neodiprion sertifier* (Geoffroy)
Newly discovered infestations in Dane and Iowa counties, plus information from a male trapping program by UW-Madison researchers, suggest that the southern two tiers of counties are generally infested. Many males were trapped on the southern unit of the Kettle Moraine State Forest but none on the northern unit.

Heavy infestations on red pine were observed in Racine County (SENW Sec. 22, T2N, R19E; NE¼ Sec. 33, T3N, R19E) and near Twin Lakes in Kenosha County (SENE Sec. 27, T1N, R19E). A heavy infestation was reported near Genoa City in Walworth County (SESE Sec. 28, T1N, R18E) and an infestation near Lake Geneva (NENE Sec. 26, T2N, R17E) that had been heavy for several years, collapsed in 1975.

The three heavy infestations observed were in 15-ft. tall red pine plantings. This is beyond the sizes which are most susceptible to damage by the sawfly. Defoliation was confined to the outer 2 or 3 rows and edges of openings in closed stands. On individual trees, defoliation was usually confined to the top half of the crown. Overwintering egg clusters were plentiful in all three infestations so more heavy defoliation is expected in 1976.

Larch Sawfly - *Pristiphora erichsonii* (Hartig)
Scattered stands of larch were heavily defoliated in Rusk, Sawyer, and Washburn counties in the Northwest District. A mid-July aerial survey indicated that populations increased throughout the North Central District with severe to complete defoliation in many stands in the northern-most counties.

Mountain Ash Sawfly - *Pristiphora geniculata* (Hartig)
Reports of defoliation on ornamental mountain ash indicated the sawfly was active over most of the state. Less defoliation was evident in the Black River Falls area (Jackson County) than the last two years, but severe defoliation occurred in the southern counties.

LEPIDOPTERA

Pecan Leaf Casebearer - *Acrobasis juglandis* (LeBaron)
High overwintering densities caused extensive shoot damage to black walnut plantations in Dane and Iowa counties. Populations collapsed in some plantings before larvae moved to the foliage and only a few larvae of the overwintering generation were found. However, some populations remained high in southern Grant, northwestern Green, and southeastern Dane counties.

Fall Cankerworm - *Alsophila pometaria* (Harris)
Spring Cankerworm - *Paleacrita vernata* (Peck)
Linden Looper - *Erannis tiliaria* Harris
A week of abnormally warm temperatures in mid-May resulted in low mortality and rapid development of larvae. By early June they were noticeable on many tree species, particularly oaks and elms, in an area covering parts of 18 townships in south central Wisconsin. Oaks on more than 2,000 acres of poor sandy sites in northwestern Dane, eastern Sauk and western Columbia counties were moderately to completely defoliated. Similar defoliation occurred in southeast Adams County and southwest Marquette County. An estimated 135,000 acres were defoliated in Marquette County. Infested oak stands were also observed over much of the rest of the state from Wisconsin Highway 70 (Washburn County) southward. Defoliation was severe over more than 40 acres of timber in bottom lands along the Black River in LaCrosse County (SW¼ Sec. 27, T18N, R8W), on the Van Loon Public Hunting Grounds, on May 30. Severely defoliated trees generally recovered well and had near full-size new foliage before the end of July. Adult emergence began about November 1 in the Southern District. Emergence peaked about November 6 when a survey of the defoliated areas near Lodi (Columbia County) was made. Adult populations were high and resulting egg numbers were extremely high. More heavy defoliation is expected in 1976.

Calosoma beetles were active in at least two infested areas on May 29. Beetle activity was reported from W½ Sec. 6, T10N, R8E in Columbia County and about 2 miles northwest of Lyndon Station in Juneau County at a rest stop on I-90-94. Larvae at the time ranged in size from 3/4" to 1" long.

Greenstriped Mapleworm - *Anisota rubicunda* Fabricius
None were found this year indicating a collapse of the 1974 heavy populations in Burnett and Washburn counties (T39N, R13&14W).

Fruittree Leafroller - *Archips argyrospilus* (Walker)
Obliquebanded Leafroller - *Choristoneura rosaceana* (Harris)
Populations of these two leaf rollers were higher than usual throughout the state. Extensive moderate defoliation of basswood occurred along the Wisconsin and Mississippi Rivers in Grant and Iowa counties. Light defoliation of oaks occurred in Adams County.

Oak Webworm - *Archips fervidanus* (Clemens)
Populations were generally above 1974 levels in the west half of the state. Colonies were common in Jackson, Burnett, Douglas and Bayfield counties.

Large Aspen Tortrix - *Choristoneura conflictana* (Walker)
Two widely separated areas of severe defoliation occurred in eastern Langlade (T33N, R12E) and southern Forest (T37N, R14E) counties. Loggers reported difficulty in peeling aspen in the defoliated areas because of drier tighter bark, and the moth flight caused concern to local residents.

Very light and scattered defoliation occurred in northern Douglas and Bayfield counties.

Spruce Budworm - *Choristoneura fumiferana* (Clemens)
The gross acreage of timber infested by the spruce budworm in the North Central District continued to increase. Three separate areas of infestation near Argonne in Forest County, Monico in Oneida County and Butternut Lake in Vilas County have coalesced. The total infested area now covers between 50,000 and 60,000 acres of spruce-fir type. Severe defoliation resulted in extensive tree mortality near Monico and Argonne (Figure 1). Most of the mortality was in balsam fir stands. Minor top-killing occurred in white spruce. Landowners in the Monico and Argonne areas worked hard to salvage much of the balsam fir killed in 1974 and 1975, and the remaining higher quality stands are scheduled for cutting in 1976.

Egg mass surveys were conducted in the North Central District the last two weeks in July, as in previous years. Egg masses were counted on 53 plots distributed throughout the infested area. Two 15" branches were removed from mid-crown on each of three trees at each plot and the egg masses were tallied. The average number of egg masses per 15" branch was 0.49 compared to 0.92 in 1974, 2.38 in 1973, 0.39 in 1972, 0.23 in 1971, and .19 in 1970. Thirty-six percent of the egg masses were parasitized. Defoliation in 1976 is expected to be light to moderate generally and occasional stands will be heavily defoliated north and east of Monico. The prediction is based on egg mass counts, size of masses, and degree of egg parasitism.

Feeding by the budworm was light on most spruce-fir stands in Douglas and Washburn counties. Severe defoliation occurred again in Section 34, T44N, R8W in Bayfield County. Considerable tree mortality has already occurred and more trees continued to die.

In northern Sawyer County (T42N, R9W) along the Totagatic River, some tree mortality occurred after three years of increasing infestation. This area is considered a deer yard, but plans are being formulated to harvest the older and more seriously damaged stands.

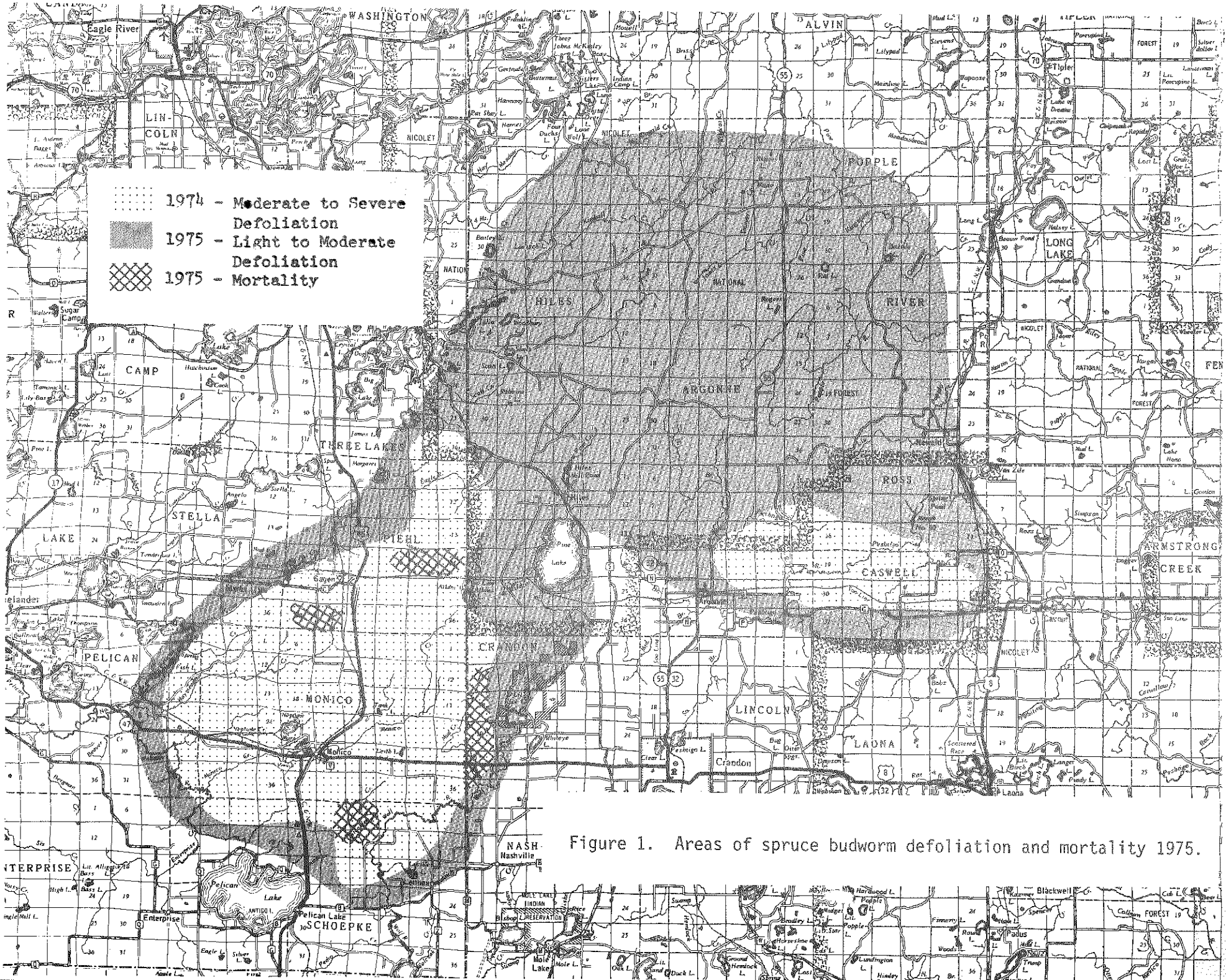


Figure 1. Areas of spruce budworm defoliation and mortality 1975.

Light to moderate defoliation occurred on about 1,000 acres of spruce-fir type in Iron County and harvesting operations were started.

Egg counts in Bayfield, Iron and Sawyer counties indicate that high populations will continue in 1976.

The minor infestation of spruce budworm in a Jackson County spruce plantation reported in 1974, practically disappeared in 1975. Only two budworm pupal cases were found in one hour of searching.

Phenological Notes: (Pertain to Forest and Oneida counties except for May 30 note):

May 13 - Second instar larvae were first collected on sticky traps.
May 20 - Larvae had ceased mining in the old needles and had migrated to the new shoots.
May 30 - Larvae mostly mature and pupating on blue spruce in Madison (Dane County).
June 3 - Instars - 15% 3rd, 67% 4th, 18% 5th.
June 10- Instars - 1% 3rd, 14% 4th, 43% 5th, 42% 6th.
June 17- Instars - 9% 4th, 21% 5th, 70% 6th.
June 24- Instars - 21% 6th, 67% pupa, 12% adults.
July 15- 80% of the egg masses hatched.

Jack Pine Budworm - *Choristoneura pinus* - Freeman

Budworm populations showed some increase in Polk County which may be an indicator of things to come. Pupal and egg counts were erratic but some were in the high category (exceeded 25 pupae per plot in 15 minutes, or less, searching; or 0.5 egg masses per 15" of needle-bearing twig taken from mid-crown). Populations in Burnett and Washburn counties remained at a low level in all stages.

Early larval counts were high in parts of Douglas and Bayfield counties over an area of about 30,000 acres. However, stands which were severely defoliated in 1974 had low populations, probably due to lack of oviposition sites. Although larvae emerged somewhat earlier than usual, cool wet weather during the first half of June delayed their development. During the latter part of June it turned unusually warm and the larvae completed their feeding cycle rapidly consuming and destroying much less foliage than usual. Consequently, only a small part of the area showed browning and moderate to heavy defoliation. Pupal counts were high over most of the area and eggs were numerous enough to indicate a potential for high populations in 1976. Some increase in pupal and egg parasitism this year may continue in 1976 and help in reducing the budworm populations.

Jack pine budworm activity elsewhere in the state was insignificant.

Phenological Notes:
Northwest District

May 19 - Larvae starting to break hibernation in Douglas County. PJ leaders 1" to 4" long, pollen flowers small, green and hard. Oak buds breaking.
May 20 - Larvae out of hibernation in all counties. No feeding noted - pollen flowers still green and hard.
May 23 - Larvae feeding on pollen flowers. Pollen starting to ripen in Burnett County. PJ leaders 3" to 10" long.

May 27 - Pollen ripe and gone in Douglas County. PJ leaders 3" to 10" long. Larvae 2nd instar.
June 10- Larvae still 2nd instars in Douglas County.
June 13- A few 3rd instars in Douglas County.
June 23- Larvae 3rd, 4th and 5th in Douglas and Bayfield counties.
June 25- Larvae mostly 4th and 5th instars with a few 6th and an occasional pupae.
July 8 - 85% pupated, some adults present.
July 9 - Adults quite numerous in Douglas County.
July 14- Majority in adult stage in all counties. Some eggs present.
July 21- Eggs starting to hatch in Douglas County.

Oak Leaf Tier - *Croesia semipurpurana* (Kearfott)
Severe early summer defoliation of 3,000 acres of high quality northern red oak occurred in southwest Menominee County (T29N, R13, 14E) and light defoliation of northern pin oak *(Quercus ellipsoidalis)* and northern red oak *(Q. rubra)* occurred in the northeastern part of Menominee County (Figure 2). Refoliation of the red oak was complete by late July at the time dead and dying branches were observed. Further inspection revealed the presence of Dothiorella canker, squirrel or porcupine damage and an oak bark beetle, *Pseudopityophthorus minutissimum* (Zimmerman). Areas defoliated by *Croesia* appear to be in the process of a type change as manifested principally by an abundance of maple reproduction and other plant indicators of northern hardwood type.

Pine Tussock Moth - *Dasychira plagiata* (Walker)
Three tussock moth larvae were found while making jack pine budworm surveys - one in Washburn County (S11, T42N, R13W) and two in Douglas County (S25, T43N, R12W).

Egg masses were found in Douglas County (Section 13, T43N, R12W and Section 27, T44N, R12W). Further checks revealed no additional eggs. No evidence of late summer feeding by newly hatched larvae appeared anywhere in the areas mentioned.

Zimmerman Pine Moth - *Dioryctria zimmermani* (Grote)
Many browned twigs (up to 30%) resulted from continued high populations in some red pine plantations in the Black River State Forest (T20N, and T21N, R2W) in Jackson County.

Similar browning of twigs on red pine occurred over extensive areas in Waupaca and Waushara counties where the new-growth had been subjected to late spring frost. Few of the insects matured in these counties.

Pine Needle Miner - *Exoteleia pinifoliella* (Chambers)
Conspicuous needle miner activity on jack pine was observed at several locations in the western half of the state. Jack pine was affected on a total area of about 1,000 acres in the West Central District. Most severe infestations were in Jackson County (Sections 32 and 33, T22N, R2W) and Clark County (Sections 9 and 16, T24N, R3W) where trees with 30% of the needles infested were commonly observed.

Noticeable yellowing of needles on branch tips was extensive in parts of Washburn County (T41 and 42N, R13W) and Douglas County (T43N, R12 and 13W) in the Northwest District.

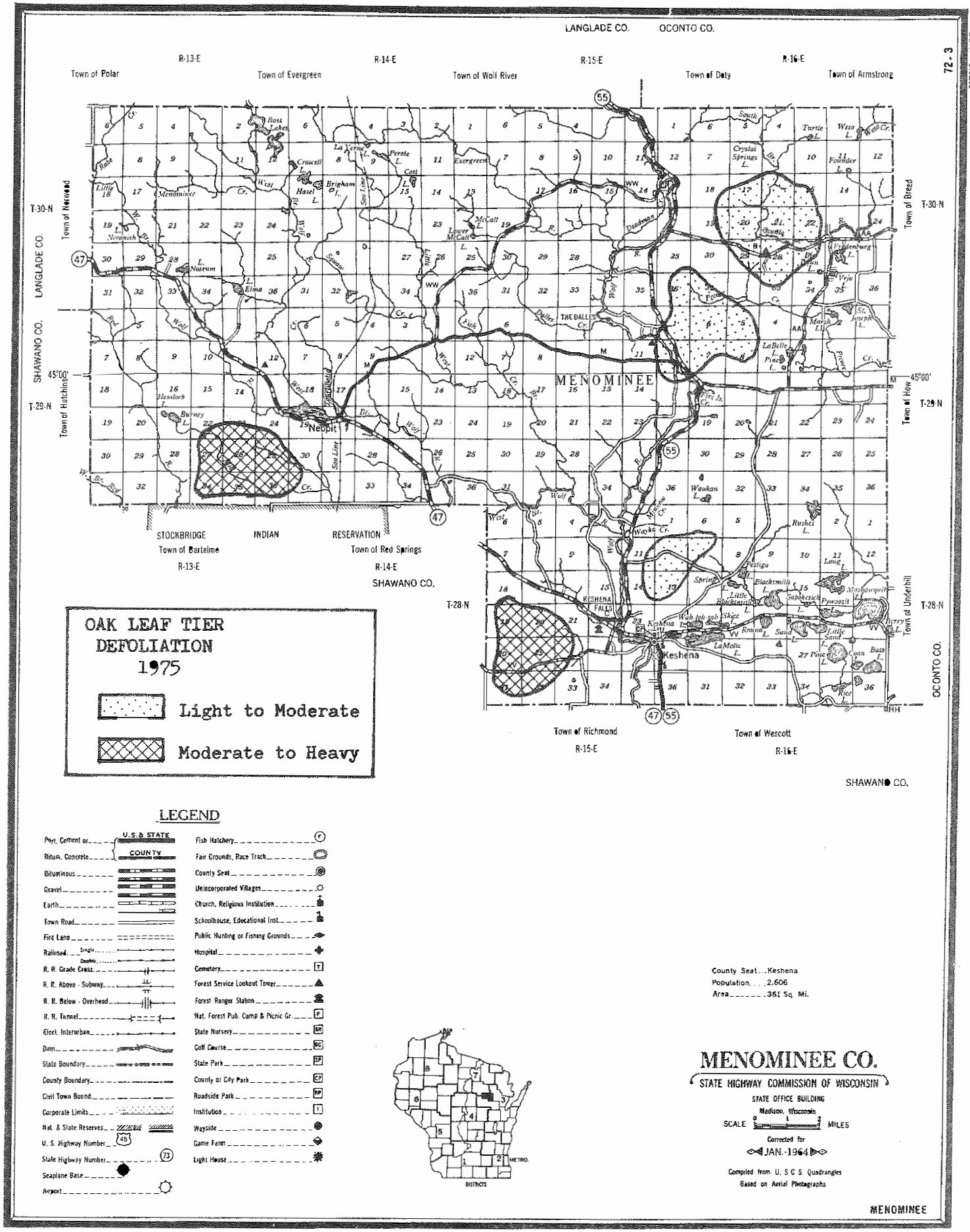


Figure 2. Defoliation by oak leaf tier *Croesia semipurpurana* (Kearfott).

Saddled Prominent - *Heterocampa guttivitta* (Walker)
Noticeable but light defoliation of maples occurred on a 40 acre area (SWSE Section 12, T32N, R28E) near Baileys Harbor in Door County.

Variable Oak Leaf Caterpillar - *Heterocampa manteo* (Doubleday)
Only scattered larvae were found in Jackson and Langlade counties in areas of previous heavy defoliation. No defoliation was reported anywhere else in the state.

Fall Webworm - *Hyphantria cunea* (Drury)
Populations were generally low. Webs were most numerous in Iowa and Grant counties along the Wisconsin and Mississippi Rivers.

Aspen Blotch Miner - *Lithocolletis tremuloidiella* (Braun)
Heavy infestations in central Oneida and Vilas counties continued in 1975.

Eastern Tent Caterpillar - *Malacosoma americanum* (Fabricius)
No apparent change in population levels in the southern counties. Areas of infestation were most noticeable in southern Dane and Rock counties. Populations were low elsewhere in the state.

Forest Tent Caterpillar - *Malacosoma disstria* Hubner
Larvae were observed at widely separated locations over the state and more reports of observations were received than have come in for several years. Most reports were of sighting single larvae, or a few at a location. Twenty to 30 larvae were found at each of two locations in Sections 27 and 33 of T21N, R4W in the Black River State Forest (Jackson County). These were the first larvae sighted there in several years. No defoliation by the insect was observed.

Mourning Cloak Butterfly - *Nymphalis antiopa* (Linnaeus)
Populations were higher in southern counties than in 1974. Noticeable defoliation of willow occurred in several areas of Dane County.

Gypsy Moth - *Porthetria dispar* (Linneaus)
About 1500 pheromone-baited traps were placed in strategic locations throughout the state by DNR, Wisconsin Department of Agriculture and USDA-Animal Plant Health Inspection Service (APHIS). Three male moths were caught in a single trap on the west edge of the Lawrence University athletic field in Appleton (Outagamie County). A single male moth was trapped in Manitowoc near Silver Creek Park (Manitowoc County). Another male moth was trapped on the north end of the Road America race track near Elkhart Lake (Sheboygan County). Two males were found in the USDA-APHIS car that was used to service all the traps mentioned above. A University of Wisconsin/Stevens Point forestry student stated that a gypsy moth larva discovered in his insect collection, for an entomology course, came from a site near Clam Lake in Bayfield County. The date of collection, and exact location of the collection were not known by the student. The host tree was basswood. An intensive search for egg masses was conducted near the multiple-catch site in Appleton by entomologists from DNR, Wisconsin Department of Agriculture, U.W. and USDA-APHIS. No egg masses were found.

Two species of gypsy moth parasites, *Brachymeria intermedia* (Nees) and *Apantales melanoscelus* (Ratzeburg) were released. *B. intermedia* were released in Douglas County and *A. melanoscelus* in Rock County (Appendix A).

European Pine Shoot Moth - *Rhyacionia buoliana* (Schiffermuller)
The insect has not been a serious problem in red pine plantations and windbreaks in counties along the Lake Michigan shore in recent years as it was in the 1950's and 1960's.

ORTHOPTERA

Oak Defoliating Grasshopper - *Dentrotettix quercus* (Packard)
Spotty defoliation occurred mostly on southerly slopes, affecting a few hundred acres of northern pin oak *(Q. ellipsoidalis)* in Jackson County. The grasshoppers were readily found but not concentrated, except on an occasional oak, in Section 10, T19N, R1E in Monroe County near Warrens.

## MAJOR FOREST DISEASES

### WILTS AND DIEBACKS

Dutch Elm Disease - *Ceratocystis ulmi* (Buisman) Moreau
Dutch elm disease is the major forest disease in Wisconsin and continues to kill millions of elms in Wisconsin's forest areas. Presence of the disease was confirmed in Iron and Bayfield counties in 1975. It is now known to be present in every county in Wisconsin.

Dutch elm disease continued to ravage the hardwood forests of the North Central District. Aerial surveys conducted during early July, when symptoms were at their peak, showed extensive damage to all stands containing elm. Hardest hit were those farm woodlots containing a high percentage of elm. Losses in some individual timberstands increased to 40% as the rate of new infections accelerated. Depressed market conditions have slowed the rate of cutting and salvage and may be causing increased native elm bark beetle populations with the higher amount of standing brood material.

In Menominee County, some cutting compartment scheduling changes have been made to facilitate harvesting the quality elm in high disease incidence areas.

Oak Wilt - *Ceratocystis fagacearum* (Bretz) Hunt
Reports from west central Wisconsin indicate that established oak wilt pockets are continuing to enlarge with occasional new infection centers being reported. The disease is a major problem in Lake Wissota State Park in Chippewa County where desirable shade trees are being lost, and the number of manhours devoted to removal of dead trees is increasing. There was no change in the statewide distribution of oak wilt in 1975 (Figure 3).

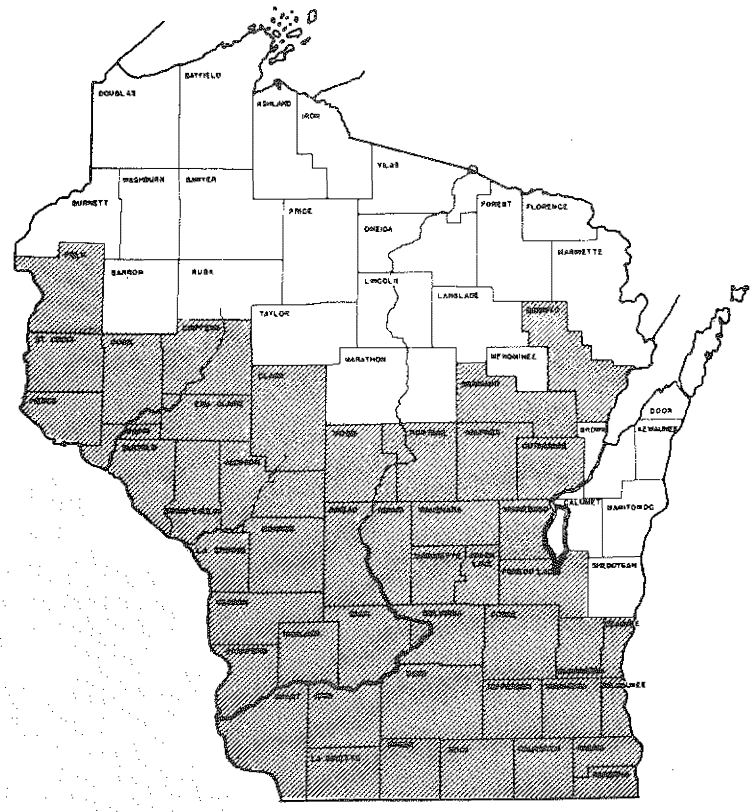

Figure 3. Known distribution of oak wilt in Wisconsin - 1975.

STEM AND BRANCH DISEASES

Aspen Shoot Blight - *Venturia spp.*
Aspen shoot blight continues to be observed in aspen regeneration areas and is causing some top kill and dieback of the current year's shoots.

Cytospora Canker of Aspen - *Cytospora chrysosperma* (Pers.) F.
Cytospora canker on the stems of aspen regeneration was reported as common in areas of Langlade, Oneida and Vilas counties. Many of the infected trees were dead or dying.

Diplodia Tip Blight - *Diplodia pinea* (Desm.) Kilk
*Diplodia pinea* was found on dying red pine shoots at Griffith State Nursery at Wisconsin Rapids and at Hayward Nursery. The shoot mortality appears to be associated with root pruning operations.

*Diplodia pinea* was collected from dying red pine shoots in the Crandall Plantation in Adams County (Sec. 27, T14N, R6E) on October 7, 1975. *D. pinea* was also found on insect-injured shoots of Scotch and red pine shelterbelts in Green and Sauk counties.

Butternut Dieback and Canker - Unknown
Widespread dying of butternut was first reported in southwestern Wisconsin in 1967. An examination of some affected stands indicated the fungus *Melanconium oblongum* Berk., the imperfect stage of *Melanconis juglandis* (E. & E.) Graves, was associated with the dieback. Several butternut stands were sampled and an investigation of the role of the fungus was

initiated in 1969 at the University of Wisconsin-Madison. *Melanconium oblongum* can be found on dead branches of butternut trees throughout the state, but cankering and dieback has only been observed to date in Columbia, Dane, Grant, Iowa, Sauk and Richland counties.

Preliminary results indicate an unidentified fungus may be involved in the cankering. The dieback may not be caused by the fungus but could be initiated by environmental stress or caused by a virus or mycoplasma.

Red Pine Shoot Blight - *Sirococcus strobilinus* Pruess

The Department of Natural Resources continued to cooperate with the U.S. Forest Service, North Central Forest Experiment Station, in an ecological study of red pine shoot blight on the Northern Highland State Forest in Vilas County. Removal of infected overstory trees is being tried as an experimental control measure. Fungicides are also being tested to determine if infection can be prevented in seedlings. Impact plots were established in areas where Lophodermium needle cast is killing the older foliage while shoot blight is killing the current year's shoots.

A shoot blight plot established by DNR Forest Pest Management personnel at Starrett Lake has been observed since 1972. No trees have died in the openings, while 59% of the trees are now dead in the understory (Table 1).

Table 1. Cumulative Tree Mortality[1/] Starrett Lake Red Pine Shoot Blight Plot, Northern Highland State Forest, Vilas County, Wisconsin (Sec. 24, T41N, R7E).

| Year | Openings (%) | Understory (%) |
|---|---|---|
| 1972 | 0 | 20 |
| 1973 | 0 | 31 |
| 1974 | 0 | 45 |
| 1975 | 0 | 59 |

[1/] Plot totals: number of trees in openings - 49
number of trees in understory - 51

ROOT ROTS

Shoestring Root Rot - *Armillaria mellea* (Vahl ex Fr.) Kummer

Sixty-four acres of red pine were planted on the Eau Claire County Forest (Section 7, T26N, R6W) in the fall of 1941 and spring of 1942. The oak overstory was girdled and poisoned with 2,4,5-T in oil in 1967. A commercial thinning was initiated in 1970 and completed in 1972. Bark beetles built up in wood left in skid rows that summer and spread to standing trees. *Armillaria mellea* infection followed.

A survey of Armillaria root rot was conducted in the plantation in October, 1975. A total of 1420 trees were sampled and 306 (21%) were dead. Fruiting bodies of *A. mellea* were found at the bases of 74 (24%)

of the dead trees. The fungus was fruiting at the bases of 47 (4%) of the remaining live trees. The survey also indicated that 10% of the red pine had been removed in previous thinnings.

Damping Off - *Fusarium spp.*
*Fusarium spp.* has been associated with damping-off of red pine seedlings in Mylone-fumigated soil in the Hayward Nursery. Seed pelleting trials with benomyl and captan indicate that captan is most effective of the two in reducing the losses.

FOLIAGE DISEASES

Lophodermium Needle Cast - *Lophodermium pinastri* (Schrad.) Chev.
*Lophodermium pinastri* caused browning of foliage of pole and sawtimber red pines in Oneida and Vilas County in May. In August, 1974 there was an unusual amount of needle browning and defoliation in the lower 1/3 of tree crowns in a red pine plantation established in 1941 on the Northern Highland State Forest (Sec. 8, T41N, R7E). Five trees were paint-marked on the boles at the junction of the live and dead crown on May 16, 1975 and will be observed annually to determine the rate of *Lophodermium pinastri* infection. Infection was also observed on red pine nursery stock at the Nekoosa Edwards Paper Company's Squirrel Lake Nursery in Oneida County.

The pathogenic strain of *Lophodermium pinastri* was also isolated from 3-0 red pine at the F. G. Wilson State Nursery at Boscobel. This is the first report of this fungus at this nursery. Infected beds were treated with maneb.

Only three Scotch pine Christmas tree plantations in Wisconsin were treated for Lophodermium needle cast in 1975. Apparently 1974 fungicide control programs prevented a major buildup of the disease. However, one Christmas tree grower did have infection on red pine nursery stock grown and planted on his land in Green County (Sec. 1, T1N, R9E).

Brown Spot Needle Blight - *Lecanosticta acicola* (Thuem.) Syd.
There were no new reports of brown spot infection in Scotch pine Christmas tree plantations in 1975. Some Christmas tree growers in west central Wisconsin continue to treat previously infected plantations as a preventative measure.

Swiss Needle Cast - *Phaeocryptopus gaumanni* (Rohde) Petr.
Forest pathologists at the North Central Forest Experiment Station, USDA, Forest Service, St. Paul, Minnesota requested that Wisconsin Christmas tree producers submit locations of Douglas fir plantations that have suspected infection of Swiss needle cast *(Phaeocryptopus gaumanni)*. The pathologists examined 11 reported plantations and found the disease present in 10 of them (Table 2). The only uninfected plantation was near Bayfield, Wisconsin.

Table 2. Known locations of Swiss needlecast *(Phaeocryptopus gaumanni)* of Douglas fir in Wisconsin, 1975.

| Owner & Location | Size | Disease Intensity |
|---|---|---|
| Dean Labus<br>Etrick Twp.<br>Jackson Co. | 5,000 trees | Heavy |
| Roland Krause<br>Door Co. | One plantation | Medium |
| Roland Krause<br>Kewaunee Co. | Two plantations<br>(80 acres) | Medium |
| Fred Niebler<br>Near Berry Lake<br>Oconto Co. | 80 acres | Heavy |
| Ron Campbell<br>Near Sobieski, WI<br>Oconto Co. | Unknown | Medium |
| Clyde Nelson<br>6 miles south of Waupaca<br>Waupaca Co. | 30 acres | Heavy |
| Ron Campbell<br>North of Saxville<br>Waushara Co. | 850 trees | Heavy |
| G. R. Kirk Co.<br>Waushara Co. | Two plantations | Light |

Air Pollution

The Forest Pest Control Section cooperated with the DNR Air Pollution Control Section in responding to complaints of air pollution injury to white pines in Lowville, Pacific and Wyocena Townships in Columbia County. The complaints were received on July 11 and the area surveyed on the ground July 14. Unusually severe needle tipburn was noted on some white pines. However, no injury was noted on hardwood trees or on air-pollution-susceptible vegetation such as wild grape. Tipburned white pine in the vicinity of Wisconsin Dells were few, however, but symptoms were severe.

An aerial survey was made of white pine needle blight in the Rio-Pardeeville area of Columbia County on July 15, 1975. This survey was part of an aerial survey for spruce budworm, Dutch elm disease, and other forest pest problems in central and northern Wisconsin. Needle blight was conspicuous in Columbia, Green, Green Lake, Marquette and Waushara counties.

In order to better delineate the areas of white pine needle blight, another aerial survey was made on July 28 in Columbia, Dane, Marquette and Sauk counties. Needle blight was conspicuous from the air in all of

them and an estimated 10-15% of the pines were affected. A ground survey of three plantations in Columbia County, on August 14, revealed a maximum of 15% of the trees showed symptoms (Table 3).

Table 3. White pine needle blight incidence, Columbia County, August 14, 1975.

| Location | Trees Examined (No.) | Trees With Tipburn (No.) | Trees With Tipburn (%) |
|---|---|---|---|
| SENE, S 22 T11N, R11E | 70 | 1 | 1 |
| SESE, S 12 T11N, R11E | 100 | 15 | 15 |
| NENE, S 2 T11N, R10E | 100 | 15 | 15 |

White pine needle blight was reported common in a 10-15 square mile area (T24N, R1E and 2E) in Clark and Wood counties. It was also severe on a few trees near Brodhead (Green County) on July 23. Examination of white pine needle blight plots established in 1968 in Green County, and in 1970 in Richland County, indicated there was no increase in the number of needle-blighted trees over previous years.

Vegetation surveys in the Village of Brokaw continued as a follow-up of previous air pollution injury in 1972-1974. DNR forest management and air pollution personnel surveyed the area weekly from June 24 through August 7, 1975. A map of the village was coded by numbering individual lots. Observations during walking surveys were recorded by coded map location. Injury patterns identified by this method were related to wind and weather conditions during the previous week to determine the probable source of injury (see Annual Report 1972-73, Forest Pest Conditions in Wisconsin). Air pollution injury to vegetation was generally less severe than in previous years. The only diagnosis of air pollution injury occurred on June 24 when interveinal necrosis, attributed to sulfur dioxide (described as light intensity), was observed on flowering crab, sugar maple, and box elder. The injury was reported in a small area 1000 feet due north of the Wausau Paper Company mill.

The Forest Pathologist was also called upon to investigate ammonia injury to vegetation in Evansville, Wisconsin. Apparently ammonia escaped from a liquid ammonia fertilizer tank and damaged field corn, sumac, black cherry and American elm.

The Forest Pest Laboratory also furnished laboratory diagnosis of various plant diseases thought to be caused by air pollution.

Needle Droop - Physiological Disorder

Needle droop is a physiological problem caused by water leaving the current year's needles faster than it can be absorbed by the roots. Reports were received, in May 1975, of red pine needle droop in open

field plantings in Bayfield, Iron and Vilas counties. An examination of these areas at that time revealed the needles were bent downward at the sheath during 1974. As the 1975 growing season progressed, the needles turned brown. By July there was some bud mortality and top kill, but most of the affected trees had normal shoots. Areas in which severe needle droop occurred in 1974 had some bud mortality and top kill, especially in low-lying areas. Most affected trees put out new growth, but it was shorter than normal. The last major occurrence of red pine needle droop in northern Wisconsin was in 1967.

Hardwood Nursery Diseases

The University of Wisconsin Department of Plant Pathology initiated studies on foliage diseases of trees and shrubs at the F. G. Wilson State Nursery at Boscobel. Nine different fungicides were tested for control of foliage diseases on green ash, nannyberry, wild crabapple, red oak, white oak, sugar maple, red cedar, gray dogwood, multiflora rose and wild grape. The results of the study will be published as a University of Wisconsin Forestry Research Note and in the American Phytopathological Society Fungicide and Nematicide Tests of 1975.

## MISCELLANEOUS

White Pine Decline and Mortality

Yellowing and mortality of sapling and pole-sized white pine was observed in 1974 and 1975 in several plantations in Iowa County (Section 23, T7N, R3E; Sections 8 & 15, T7N, R4E).

Some trees gradually turned yellow, declined, and died over two growing seasons. Others apparently yellowed and died in one growing season. The symptoms occurred in groups of 10 - 20 trees. In each group, about half the trees were dead and the rest yellow. All the groups were on ridge tops.

No insects or diseases, which could have caused the mortality, were found in association with the affected trees. The syndrome was tentatively explained by the area forester as root mortality caused by excessive soil moisture in the spring and subsequent drought. The soils involved are characterized by occasional heavy clay lenses. Because of their ridge top locations the trees would be especially vulnerable to drought if they had suffered previous root mortality.

White Cedar Decline

Decline of white cedar in the Cedarburg Bog was investigated on March 13, 1975. White cedar in the string bogs were dying from the tops downward in the wettest areas. Trees on higher, more solid ground bore little evidence of sooty mold or leaf miner infestations which were present on trees on the wetter sites. Tamaracks and other tree species had apparently been killed by high water near the periphery of the wet areas. The top of a dam, which had been in place since 1959, had been removed in 1969. Tree-ring development, examined in cores from affected trees, indicated that they had undergone periods of stress.

A follow-up visit to the bog on November 12, 1975, left the impression that high water may be responsible for the decline. The water level then was 12" to 14" lower than it was on March 13, and there was much evidence of cedar leaf miner activity. White cedar in low outlying

areas to the north and east of the UW-Milwaukee field station also had thinned foliage. Roots of one tree exhibiting thinned foliage were examined. Two large roots about 6" below the soil surface were dead. Smaller roots and rootlets in the zone between the large roots and the soil surface were alive.

Other observations noted the presence of large old white spruce in the bog, and that Eutypella canker of maple was common in the bog and in a northern hardwood stand just west of the field station. White pine needle blight was conspicuous on less than 10% of the trees in a plantation along Highway 33 north of the bog.

Meadow Vole - *Microtus pennsylvanicus*
Overwintering populations of a meadow vole were extremely high in the northwestern and northcentral counties. Millions of young plantation-grown pines were girdled and turned yellow in March and April. Many partially girdled trees survived until late summer.

Christmas tree growers suffered heavy dollar losses, especially those that lost Austrian and Scotch pines within one or two years of harvest.

Salt Damage
Heavy use of salt on roads damaged and killed many roadside pines, spruces and some hardwoods.

Winter Injury
Very little damage occurred on conifers during the winter and spring of 1975. Even the more susceptible "Spanish" strain Scotch pine showed little injury.

Drought
Drought conditions were widespread throughout the state during July and August. Approximately 100 acres of spring-planted seedlings were killed in Clark County for the second year. Jack pine seedlings and saplings were damaged on a 1,200-acre area of deep sand in the Black River State Forest (T22N, R2 & 3W). Similar damage occurred in Eau Claire County north of the Eau Claire River (T26N, R6W). Mortality of young jack pine reproduction was common in Burnett, Washburn, Douglas and Bayfield counties.

# APPENDIX A

## Biological Control Program

By
David J. Hall[1/]

I. Parasite Survey

A. Collections - Three new insect collection sites were added bringing the total to seven. The new sites are located at Wyalusing State Park (Grant County), Blue Mound State Park (Iowa County) and Storrs Lake Public Hunting Ground (Rock County). An estimated 5,000 immature insects were collected from all locations.

Malaise traps were placed at the collection sites at Black River Falls (Jackson County), Brule radio tower (Douglas County), Pelican Lake (Oneida County), Northern Unit Kettle Moraine State Forest (Fond du Lac County), and Wyalusing State Park. Eighty-three pint jars of specimens were collected containing a total of about four hundred thousand insects. These were transported to the Entomology Department, University of Wisconsin, for sorting and identification by Dr. Roy Shenefelt and his staff.

The lack of a technician at Antigo meant that regular larval collections could not be made at the Pelican Lake site during 1975. This was particularly unfortunate because the site yielded a great variety of species in 1974, including a probable new species of Gelechiidae.

B. Rearing - The rearing operation at the Pest Management Laboratory was conducted essentially as described in the 1974 annual report with the exception of humidity control. During February a two-chambered cabinet was built that enabled control of humidity at 70% and 90%. This prevented foliage and insects from drying out, greatly increasing insect survival and reducing the effort required to keep the foliage fresh.

About 800 adult lepidoptera and sawflies and 2000 - 3000 adult parasites were delivered to Dr. Shenefelt. Cold treatment of several hundred pupae, in clear plastic one-ounce creamer cups, was started in the fall so the pupae could meet diapausing requirements.

C. Larval Identification - The larval reference collection now has approximately 400 specimens. About 100 of them are named to genus or species. The list of names of reared adults will help put names on many more.

Color slides were taken of a number of larvae as they arrived at the lab. Slides of larvae and their feeding and webbing patterns will help in future identification.

[1/]Forest Entomologist, Department of Natural Resources, Madison, Wisconsin.

D. Dr. Shenefelt has returned the names of over 100 species of Lepidoptera to date. These have been entered onto the data cards. No names of parasites have been returned yet.

II. Parasite Releases

Releases of three gypsy moth parasitoid species were planned for 1975. *Compsilura concinnata Meigen* (Tachinidae) was not available. Two other species were released. Locations and dates of all gypsy moth parasite releases, for the years 1973-1975, are indicated on the state outline map (Figure 1).

A. *Apanteles melanoscelus* (Ratzeburg). Two releases of 1000 cocoons each were made on the Storrs Lake Public Hunting Ground (NENE Sec. 25, T4N, R13E) in Rock County on May 9 and May 15. No new parasite cocoons were found in host insects at the release site.

B. *Brachymeria intermedia* (Nees). One release of 1000 adults was made in Douglas County (center of Section 33, T46N, R10W), in a heavy jack-pine budworm infestation, on July 3. About 90% of the budworm population was in the pupal stage. Subsequent pupal collections yielded no *Brachymeria*.

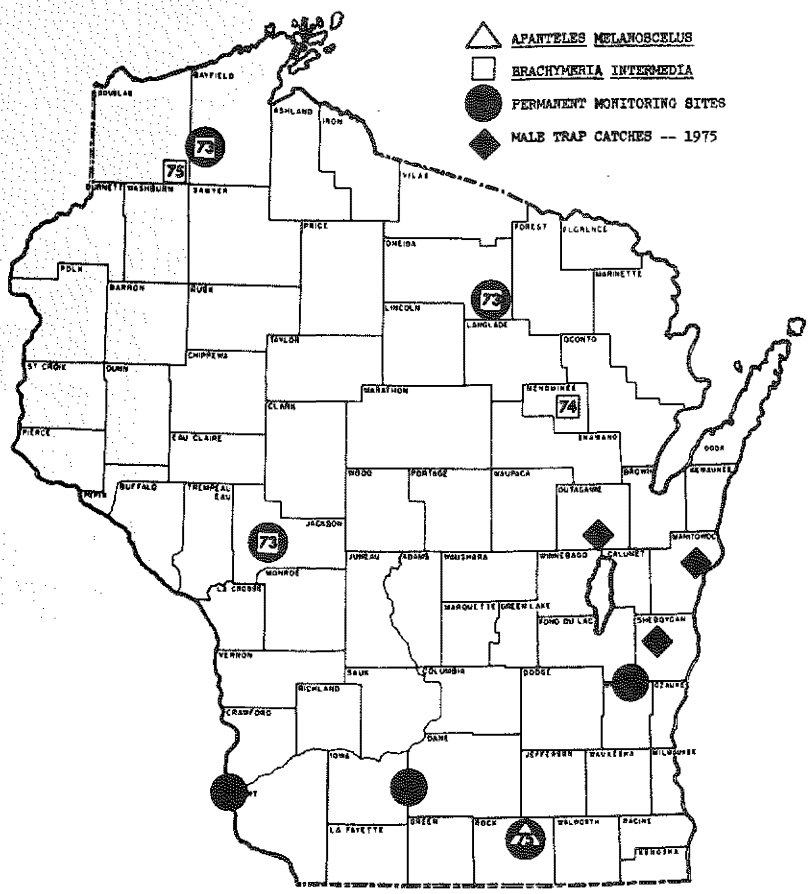


Figure 1. Locations of gypsy moth parasite releases, permanent parasite monitoring sites, and 1975 male gypsy moth trap catches. Numbers indicate year of parasite releases.

# APPENDIX B

## A Preliminary Evaluation of Some Insecticides To Control Walnut Bud Insects

By Frank Morse[1/]

### INTRODUCTION

Many thousands of black walnut seedlings have been planted on several thousand acres by hundreds of landowners in Wisconsin during the last 15 years. This program has been carried out by landowners seeking a lucrative return on a forest investment for their land, money and time. Research reports from state and federal agencies have projected a high return in relatively few years from growing high quality black walnut in plantations.

However, as these first plantations reach 5, 10, or 15 years of age, the results of most are discouraging. Too many trees were stunted, limby, deformed, and without a central main stem to build upon. Many factors have been blamed for this poor form. These include: herbaceous competition, poor soil, early frosts, late frosts, genetics, insects, diseases, and wide spacing.

Investigations started in 1973 and 1974 indicated that much of the "late frost" damage, that had resulted in loss of terminal bud growth and forking, was being caused by one or more species of insects that were mining in the buds before or about the time growth started in the spring. The major species causing this damage has been identified as the pecan leaf casebearer - *Acrobasis juglandis*.

### OBJECTIVES

A pilot study was started in 1975 to test some available insecticides for the control of the pecan leaf casebearer and other early spring bud feeding insects. Objectives of this study were:

A. To determine if terminal buds can be protected from destructive insects.
B. To test insecticides and determine the timing of applications.
C. To determine if protecting terminals with insecticide will result in straighter, more rapid growth.

### METHODS

The first plantation treated was in Trempealeau County. The treatment was used to develop techniques and to determine the rate of application. Three materials were used and plots were not established. Data from this plantation was not used in the evaluation which was done on July 31 when signs of *Acrobasis* were harder to identify. Populations of the insect were low and damage to shoots was erratic and scarce.

[1/]Forest Entomologist, Department of Natural Resources, Black River Falls, Wisconsin.

Three other plantations were selected for the trials, one each in Buffalo, Trempealeau, and Vernon Counties. Trees ranged from 5 to 12 feet tall. Test blocks of 80 trees were selected and subdivided into 20 tree plots. Three plots (60 trees) were treated and one plot (20 trees) was left untreated as a check.

The distal 6 to 15 inches of the main terminals were sprayed using a 2-gallon compressed air sprayer with a double nozzle wand and a cylindrical plastic wind deflector. The equipment had been developed and used for spraying white pine terminals for white pine weevil control. Between 1¼ to 1½ quarts of spray were required to treat the 60 trees in each block.

Materials selected for these tests were Lindane at 0.5% and 0.25%; Methoxyclor at 1.0% and 0.5%; Thiodan at 0.5%; Ortho Isotox insect spray (contains Meta-Systox R., Sevin, Kelthane); Ethion .62 in oil; and dormant oil.

The plots were sprayed between April 25 and May 1, 1975. Examination of overwintering hibernacula of the pecan leaf casebearer on May 1 indicated that the larvae had not broken hibernation at that time. Observations in 1974 had showed that larvae were already active in late April.

The objective of the treatments, stated earlier, was to protect main terminals. This was to be accomplished by killing larvae before or as they left hibernacula, and before they could penetrate and damage the buds.

Terminal growth and larval development started simultaneously in 1975 due to a prolonged cold spring. Shoot development was rapid and vigorous, and stayed ahead of the larval feeding, therefore casebearers did not destroy many buds, nor cause serious damage to the new terminals before they moved to the developing leaves for feeding.

Treatments were evaluated during June and July. The bases of current terminals were examined for the presence of feeding, webbing, or early larval cases left by casebearers. Approximately 20 treated trees and 20 untreated check trees were examined and tallied in each block. The number of terminals with signs of casebearer activity were recorded in each plot over the total number examined for each plot, e.g., 6/20. More or less than 20 trees were examined in some plots.

## RESULTS AND CONCLUSIONS

Methoxyclor consistently gave the best results. Thiodan, Lindane and the Isotox mixture were about equally effective and gave good results. The emulsifiable oil was completely ineffective (Table 1).

Further testing of the effective materials, and additional chemicals, including Sevin and Orthene, is recommended.

Table 1. Percent of Terminal Buds Damaged - 1975 Walnut Bud-Insect Control Test Plots.

| Pesticide | Buffalo County | | Trempealeau County | | Vernon County | | Combined Totals (Terminals Damaged) | |
|---|---|---|---|---|---|---|---|---|
| | Untreated % | Treated % | Untreated % | Treated % | Untreated % | Treated % | Untreated % | Treated % |
| Lindane 0.50% | 80 | 10 | 40 | 10 | 62 | 11 | 57 | 10 |
| Lindane 0.25% | not evaluated | | 50 | 10 | 100 | 22 | 76 | 19 |
| Methoxychlor 1% | not evaluated | | 45 | 15 | 71 | 0 | 56 | 8 |
| Methoxychlor 0.5% | not evaluated | | 45 | 0 | 83 | 5 | 65 | 2 |
| Thiodan 0.50% | 70 | 20 | 35 | 15 | 84 | 5 | 66 | 10 |
| Isotox Insect Spray (Carbaryl 5%, Meta-Systox-R 5%, Kelthane 18%) @ 3 tbsp./gal. water | 60 | 10 | 50 | 15 | 58 | 6 | 55 | 10 |
| Emulsifiable Oil @ 8 tbsp./gal. water | 40 | 50 | 60 | 50 | 79 | 90 | 63 | 65 |
| Ethion .67% in oil @ 8 tbsp./gal. water | 30 | 10 | 45 | 20 | 81 | 24 | 57 | 18 |

# APPENDIX C

## Experimental Aerial Application of Dimilin and Thuricide for Control of the Jack-Pine Budworm, *Choristoneura pinus* Freeman

By
Roland B. Stewart[1/]

## INTRODUCTION

The jack-pine budworm, *Choristoneura pinus pinus* Freeman, is a serious defoliator of jack pine, *Pinus banksiana* Lamb. Larvae feed first in the pollen or in the newly expanding buds and needles. In the later instars they feed on the new growth chewing off needles at their bases. If feeding is extensive and all of the new growth is consumed larvae will feed upon the old foliage. Severe defoliation causes top killing and often tree mortality. Numerous natural factors tend to keep the budworm populations at endemic levels. Periodically, however, populations do erupt to epidemic proportions. These frequent outbreaks have damaged jack pine stands in the Lake States since 1923. To prevent this damage it is frequently necessary to use chemical suppression. At present there is no effective chemical registered for use against the jack-pine budworm. The two chemicals tested have proven effective against many lepidopterous larvae. THURICIDE 16B gave promising results when applied by mist blower against the jack-pine budworm in 1973.

## OBJECTIVE

To determine the effectiveness of three THURICIDE formulations and three rates of application of DIMILIN W-25 (TH6040) applied by aircraft for control of the jack-pine budworm, *Choristoneura pinus pinus* Freeman.

## COOPERATION

This experimental project was a cooperative effort between the Sandoz, Inc., Thompson - Hayward Chemical Co., University of Wisconsin, and Wisconsin Department of Natural Resources.

## INSECTICIDES

THURICIDE is a microbial insecticide containing spores and crystals of *Bacillus thuringiensis* Berliner. This is a bacterium toxic to many lepidopterous insects when ingested, but totally harmless to other forms of life. Each of the following formulations was applied on 80-acre blocks of jack-pine timber:

THURICIDE 16B, 80% concentrate + 20% water to make .547 gal/Acre.

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THURICIDE 24B, 75% concentrate + 25% water to make .389 gal/Acre.

THURICIDE 32B, 80% concentrate + 20% Dowanol TPM + Spreader sticker to make .273 gal/Acre.

DIMILIN TH W-25 (TH 6040) is an insect growth regulator which, when ingested, interferes with the formation of the insect's cuticle. This causes problems during ecdysis and they eventually die from starvation or ruptured cuticle. One gallon of each of the following mixtures of DIMILIN was applied per acre on 80-acre blocks of jack-pine timber:

.06 pound AI* in water to make 1 gallon
.12 pound AI in water to make 1 gallon
.24 pound AI in water to make 1 gallon

*AI - active ingredient.

PROJECT PLANS

Early budworm larval counts were made to determine test areas to be used. Counts of 20 second and third instar larvae for 30 shoots and flowers were considered sufficient to give adequate populations for pesticide testing. Six 80 acre blocks were selected close to the Solon Springs airport where the base of operations was to be set up. These blocks were one mile long (80 chains) by ten chains (660 feet) wide with sufficient open-grown jack-pine so that sampling could be done without the aid of pole pruners. They were also well away from any lakes or streams. All blocks were in Douglas County, T45N, R10W.

TREATMENT

Larval development was closely watched and the target date set for June 25 when a majority of the larvae would be in the 4th and 5th instars. These later instars feed outside of the webs and stand a better chance of ingesting the sprayed material.

A Piper Pawnee spray airplane operated by the Reabe Flying Service, Waupun, Wisconsin, arrived the afternoon of June 25 equipped with 4 Micronair rotary atomizers, which were already calibrated. The aircraft was to fly 50 feet above the forest canopy at approximately 95 miles per hour. An effective swath width of 66 feet was assumed.

THURICIDE 16B was applied on the west side of Section 7, and THURICIDE 24B on the north side of Section 17 on the evening of June 25. Conditions were ideal with very little wind and the air temperature at 75°F within five feet of the ground.

DIMILIN formulations were applied early on the morning of June 26. Winds were light and the air temperature 60°F. The 0.06 pound-per-acre rate was applied on the south side of Section 19, 0.12 pound per acre on the south side of Section 17, and 0.24 pound per acre on the north side of Section 20.

The THURICIDE 32B formulation was applied last, following DIMILIN, on the north side of Section 15. Winds at the time varied from 6 to 8 miles per

hour and the air temperature was 65°F. Due to a malfunction of the loading equipment only 60 acres were treated with THURICIDE 32B.

Section 18 served as the untreated check area.

SAMPLING METHOD

Courses to be traversed in pre- and post treatment larval sampling and plots were marked in all blocks on June 24. A series of ten plots was used as a sampling unit. This was replicated two times within each spray block. Plots were placed along a "V-shaped" diagonal course across the lines of flight. At each plot ten 15-inch twigs were clipped from at least five different trees. All larvae and pupae on these twigs were counted and recorded. Similar counts were made in an unsprayed check area about a mile from the sprayed blocks. Pre-spray counts were made in four spray blocks and the check area on June 25. The remaining two blocks were completed on June 26 immediately after spraying. Otherwise the test could not have been completed since the pilot was leaving the area that morning. DIMILIN is slow in affecting insects and should not have caused any change in populations in that elapsed time. Post spray counts were made 14 days after application in all spray blocks plus the check area.

RESULTS

The percent of population reduction due to the pesticides was computed using Abbott's formula. This takes into account the natural mortality as determined from the control blocks. THURICIDE formulations performed well (Table 1).

Table 1. Percent control of Jack-Pine Budworm, *Choristoneura pinus* Freeman, with Aerial Applications of DIMILIN W-25 and THURICIDE Formulations on Jack-Pine in Douglas County - 1975.

| Pesticide | Rate of Application per Acre | Control (%) |
|---|---|---|
| DIMILIN W-25 | 0.06 lb. AI/gal. | 35.9 |
| DIMILIN W-25 | 0.12 lb. AI/gal. | 28.4 |
| DIMILIN W-25 | 0.24 lb. AI/gal. | 8.7 |
| THURICIDE 16B | 0.547 gal. | 96.4 |
| THURICIDE 24B | 0.389 gal. | 98.1 |
| THURICIDE 32B | 0.273 gal. | 74.1 |

DISCUSSION AND CONCLUSIONS

No criteria for satisfactory control have ever been determined for jack-pine budworm. Previous treatments using DDT at one pound in one gallon of fuel oil per acre gave 80% population reduction which was considered satisfactory in Wisconsin in preventing serious defoliation. THURICIDE 16B and 24B certainly performed better than that achieving close to 100%

control. Wind and other problems interfered with the test of THURICIDE 32B. However, all did well enough to warrant further testing to determine if these results can be achieved consistently.

Results from the DIMILIN tests were not good. However, a fairly large amount of this material must be ingested by the insect to cause mortality. Since the insects were in the later instars and close to pupation, many of them did not consume much foliage after the application. This material deserves further testing against the jack-pine budworm. Application when larvae are in the earlier instars would certainly be one possibility. Hopefully, we will have sufficient population in 1976 to conduct further tests.

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